Basic Method

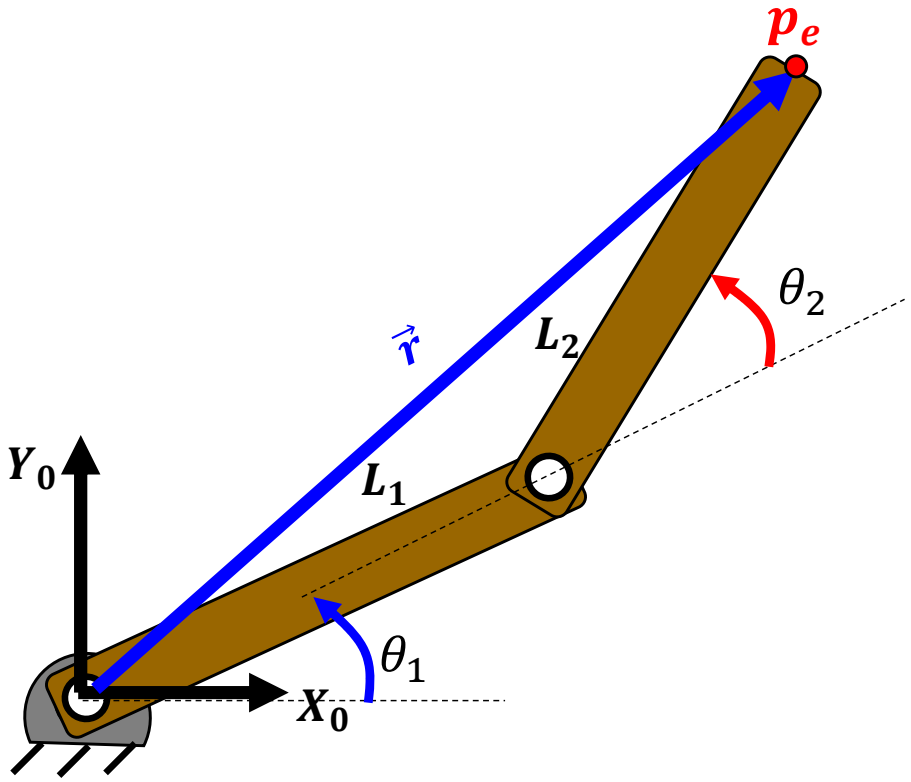
- For an n-link robot with joint variables $q_1 \ldots q_n$, With forward kinematics:

$$T_n^0 = \begin{bmatrix} R_n^0 & o_n^0 \\ 0 & 1 \end{bmatrix}$$

1) Write position o_n^0 equations
2) Take derivative for velocity
3) Put in matrix form $\dot{X} = J\dot{\theta}$

Example – 2-Link Planar Arm

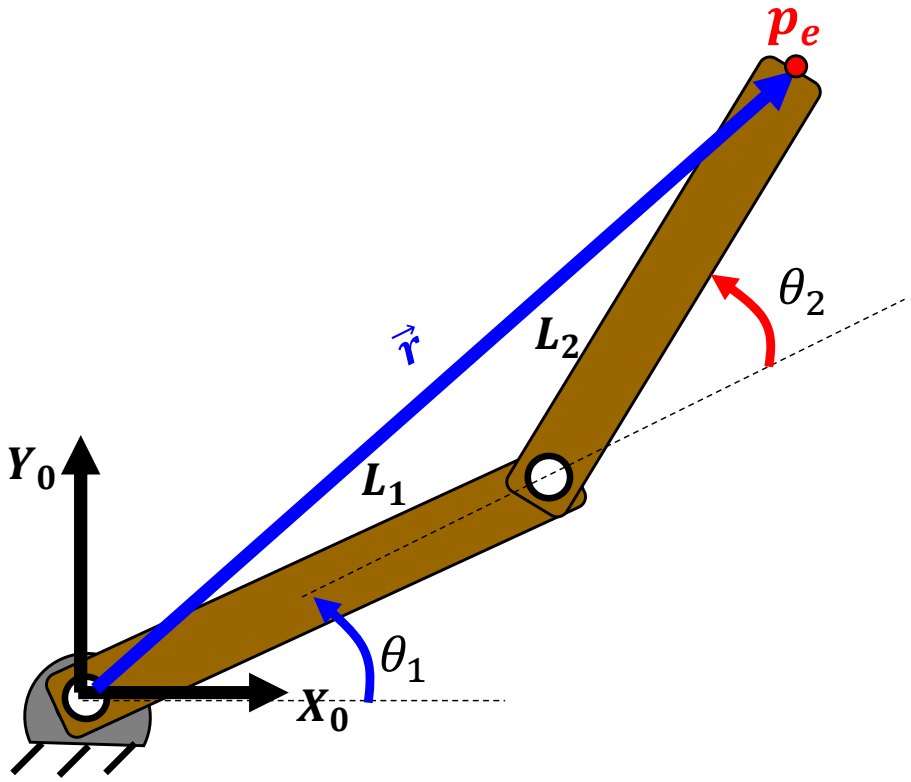
- Given $L_1,\ L_2$
- Find Jacobian using basic method



Example – 2-Link Planar Arm

1) Write position FK equations

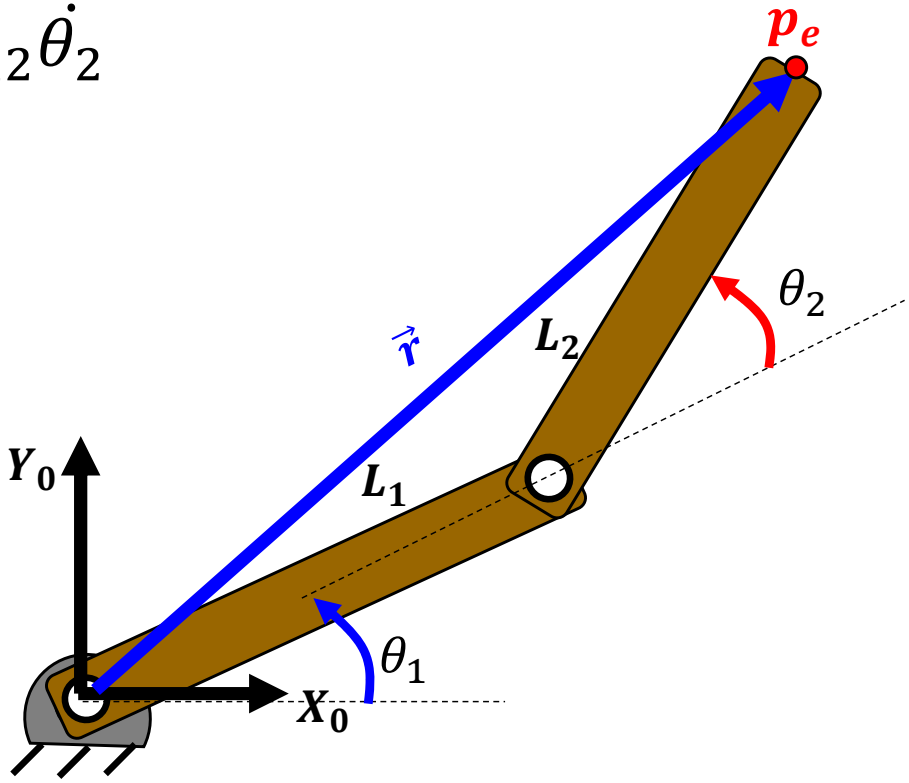
$$x = L_1 c_1 + L_2 c_{12}$$
$$y = L_1 s_1 + L_2 s_{12}$$



Example – 2-Link Planar Arm

2) Take derivative for velocity

$$\dot{x} = (-L_1 s_1 - L_2 s_{12})\dot{\theta}_1 - L_2 s_{12}\dot{\theta}_2$$
$$\dot{y} = (L_1 c_1 + L_2 c_{12})\dot{\theta}_1 + L_2 c_{12}\dot{\theta}_2$$



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3) Put in matrix form $\dot{X} = J\dot{\theta}$

$$\begin{bmatrix}\dot{x}\\ \dot{y}\end{bmatrix} = \begin{bmatrix}-L_1 s_1 - L_2 s_{12} & -L_2 s_{12}\\ L_1 c_1 + L_2 c_{12} & L_2 c_{12}\end{bmatrix}\begin{bmatrix}\dot{\theta}_1\\ \dot{\theta}_2\end{bmatrix}$$